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Title: C-AAC External Dose Greater Than Expected (Moonrock Exposure)

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C-AAC External Dose Greater than Expected (Moonrock Exposure)



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Internal vs External Dose

- Internal dose is received from an ***intake*** when material enters and is deposited in the body via inhalation, ingestion, injection, or absorption, causing internal radiation dose to the whole body, organs, and tissues
 - Internal dose is calculated based on InVivo or InVitro bioassay measurements
 - Examples: 2018 Pu-238 puncture wound, recent Pu-238 contamination event
- External dose is received from a radiation source outside the body, causing a dose to the whole body, extremities, organs, and tissues via direct ionizing radiation
 - This is directly measured using external dosimeters, such as TLDs, EPDs, or extremity dosimeters
 - Examples: ARIES Muffle Furnace exposure, Moonrock exposure

Item of interest: Moonrock



Item in question:

“Moonrock”

- Maybe Salt Scrub
- Contains Al, Ca, Na, Mg, Pu, and Li
- Pu is not homogeneously distributed

Net weight:

- 1015 g
- 204 g of Pu
- Listed as MT-52

What Happened?

- January 2018 AMPP retrieved item from Vault for characterization and disposal
 - Stored and handled material in a shielded glove box
 - No unanticipated dose received by AMPP personnel who handled material
- November 2019 AMPP requested LIBS analysis from C-AAC to identify elemental content of non-actinides
- Moonrock was moved from AMPP glovebox to C-AAC glovebox
- C-AAC was unaware of the high dose rate (americium content)
 - C-AAC handled this item as if it was not high dose
 - Stored and analyzed material in an unshielded glove box
- Result was dose above what was expected to one individual in November-December 2019 and January 2020

Communication Breakdown

- AMPP-4 regularly handles high dose items
- AMPP-4 works primarily in gloveboxes with leaded gloves/windows and often additional lead shielding
- C-AAC gloveboxes are set up to perform chemical tasks
 - Analytical chemistry primarily with small samples
 - No leaded gloves; thin gloves for operational dexterity
- High dose items are unusual for the C-AAC, and require special care because the standard glovebox environment is not designed around high dose items
- Essential differences between these work processes/environments went unrecognized, resulting in uncharacterized radiological hazard, inadequate radiological controls, and corresponding unanticipated dose
- A couple of opportunities to investigate unusual dose in Feb - March 2020, but dose was attributed to MR&R Vault activities
- Employee was denied access to Vault in June 2020; that drove investigation and identification of the source of the exposure

Immediate Action Taken

- The worker involved was removed from high dose work for the remainder of CY2020
 - Moved employee from quarterly dosimetry to monthly dosimetry
 - At the close of CY2020, no occupational dose limits will have been exceeded
- C-AAC changed process to require recent dose measurements to be provided for all items received
 - Greater emphasis on radiological conditions
 - If the dose of a nuclear material containing item is unknown, it will not be received

Actions identified at FF (ref. ORPS Report)

- Posted C-AAC glovebox into an abnormal condition and restricted its access
 - Paused MR&R Legacy Residue RCD operations pending completion of comp measures
 - Shielded the 5-quart SAVY container and applied a TID to the SAVY
 - Develop a recovery plan to return the item to AMPP-4 for disposition
 - Perform dose mapping of first floor legacy material locations
 - Shift order entry for performing dose surveys when moving special nuclear material (SNM)
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- Strengthen fissile material handler (FMH) training for radiological surveys upon material moves
 - Use this event as a topic for the quarterly FMH training
 - Develop criteria for performing dose surveys prior to releasing from an NMCA and/or potential process deviation
 - Evaluate governing procedure for process improvements when performing transactions
 - Develop a documented method to ensure clear and concise communication of additional hazards of material being moved
 - Develop an automated dosimetry system process to flag anomalous employee dose
 - Develop and disseminate an event lessons learned to include a briefing to the ALARA Committee
 - Perform an investigation and causal analysis of the event

Common Themes in Recent Events

- Legacy Materials
 - Must consider all available information, history to inform hazard analysis
 - Make conservative assumptions in absence of data
- Hazard Identification and Control
 - Ask questions about what information you have and whether you need more
 - Engage RCTs to determine radiological hazards and prescribe controls
- Procedure Adherence
 - Ensure procedures are clear and workers understand expectations
 - Hold workers accountable to implementing requirements
- Recognizing Change
 - A slight deviation from what we usually do can drive need for additional steps
 - Changes in material characteristics or behavior, quantity, process, environment warrant pause and consideration for hazard evaluation and adjustment of controls
- Communication among work groups
 - Moving materials between groups should trigger communication and engage support
 - Dose hazards, change in environments, need for RCTs should be communicated

Timely response to events, critical self-evaluation, continuous learning, and improvement are essential for safe operations and successful mission execution.

QUESTIONS